

**DIRECTIONS:** Write notes to the left margin (10), Underline important points (10), Circle things that you need clarification on (10), write a summary, 2 to 3 sentences (20), Question for discussion (50).

**What Dreams Are Made Of** *Technologies that reveal the inner workings of the brain are beginning to tell the sleeping mind's secrets* By Marianne Szegedy-Maszak 5/7/06



Strange images appear from long-forgotten memories. Or out of nowhere: You're roller-skating on water; your mother flashes by on a trapeze; your father is in labor; a friend dead for years sits down at the dinner table. Here are moments of unspeakable terror; there, moments of euphoria or serenity. Shakespeare wrote, "We are such stuff as dreams are made on," and 300 years later, Sigmund Freud gave the poetry a neat psychoanalytic spin when he called dreams "the royal road to the unconscious." The movies that unfold in our heads some nights are so powerfully resonant they haunt us for days--or inspire us. Mary Shelley dreamed of Frankenstein before she created him on paper; the melody to "Yesterday" came to Paul McCartney as he slept.

Everybody dreams--yet no one, throughout history, has fully grasped what the dreaming mind is doing. Are the nightly narratives a message from the unconscious to the conscious mind, as Freud believed? Or are they simply the product of random electrical flashes in the brain? Today, researchers aided by powerful technologies that reveal the brain in action are concluding that both schools of thought hold truth. "This is the greatest adventure of all time," says Harvard psychiatrist and dream researcher J. Allan Hobson. "The development of brain imaging is the equivalent of Galileo's invention of the telescope, only we are now exploring inner space instead of outer space."

**Mind-brain dance.** The dream researchers' new tools, functional magnetic resonance imaging and positron emission tomography (PET) scanning, have been used for some time to capture the waking brain at work--making decisions, feeling frightened or joyous, coping with uncertainty. And those efforts have shown clearly that psychology and physiology are intimately related: In someone suffering from an anxiety disorder, for example, the fear center of the brain--the amygdala--"lights up" as neurons fire in response to images that trigger anxiety; it flickers in a minuet with the center of memory, the hippocampus. Scanning people who are sleeping, too, suggests that the same sort of mind-brain dance continues 24 hours a day.

"Psychology has built its model of the mind strictly out of waking behavior," says Rosalind Cartwright, chair of the department of behavioral science at Rush University Medical Center in Chicago, who has studied dreams for most of her 83 years. "We know that the mind does not turn off during sleep; it goes into a different stage." Brain cells fire, and the mind spins. Problems find solutions; emotional angst seems to be soothed; out-of-the-box ideas germinate and take root.

***The door between the kitchen and the garage was split, so you could open the top half without opening the bottom half. It was the only safe way of doing it, because we had a rhinoceros in the garage. The garage was a lot bigger, though; it was also sort of a basement, and led underneath the rest of the house. My mother was cooking dinner, and I went into the bathroom where my brother Stuart was. The rhinoceros punched a hole in the floor with his horn. - Madeline, third grade***

What to make of young Madeline's dream? To Freud, had he met her, Madeline's rhinoceros horn would almost certainly have symbolized a penis, and the animal's violence would have been an expression of normal but threatening sexual feelings toward her brother--or perhaps of a fear of men in general. Freud saw dreams as deeply buried wishes disguised by symbols, a way to gratify desires unacceptable to the conscious mind. His ideas endured for years, until scientists started systematically studying dream content and decided that actually, something less exotic is going on.

"Dreams do enact--they dramatize. They are like plays of how we view the world and oneself in it," says William Domhoff, who teaches psychology and sociology at the University of California-Santa Cruz. "But they do not provide grandiose meanings." Domhoff bases his view on a study of themes and images that recur in a databank of some 16,000 dreams--including Madeline's--that have been collected as oral narratives and are held at Santa Cruz. (The narratives can be read at [www.dreambank.net](http://www.dreambank.net).)

Post-Freudians might argue that the monsters lurking in children's dreams signal a growing awareness of the world around them and its dangers. Young children describe very simple and concrete images, while the dreams of 9- and 10-year-olds get decidedly more complex. A monster that goes so far as to chase or attack might represent a person who is frightening to the child during waking hours. "Dreaming serves a vital function in the maturation of the brain the child during waking hours and in processing the experiences of the day," says Alan Siegel, professor of psychology at UC Berkeley and author of *Dream Wisdom*.

**Nonsense.** Physiology purists, who would say that Madeline's brain is simply flashing random images, got their start in 1953 with the discovery of rapid eye movement sleep. Using primitive electroencephalograms, researchers watched as every 90 minutes, sleepers' eyes darted back and forth and brain waves surged. Then, in 1977, Harvard psychiatrists Hobson and Robert McCarley reported that during sleep, electrical activity picked up dramatically in the most primitive area of the brain--the pons--which, by simply stimulating other parts of the brain, produced weird and disconnected narratives. Much like people looking for meaning in an inkblot, they concluded, dreams are the brain's vain attempt to impose coherence where there is none.

Or maybe that's not the whole story, either, said a young neuropsychologist at the Royal London School of Medicine 20 years later, when his findings hinted that dreaming is both a mental and a physical process. Mark Solms showed that dreams can't be explained as simple physical reactions to flashes from the primitive pons, since some of the most active dreamers in his study had suffered brain damage in that area. On the other hand, in those with damage to regions of the brain associated with higher-order motivation, passionate emotions, and abstract thinking, the nightly movies had stopped. That seemed a sign that dreams might indeed express the mind's ideas and motivations. "It is a mistake to think that we can study the brain using the same concepts we use for the liver," says Solms.



"From my perspective, dreaming is just thinking in a very different biochemical state," says Deirdre Barrett, who teaches psychology at Harvard and is editor of the journal *Dreaming*. The threads can be "just as complex as waking thought and just as dull. They are overwhelmingly visual, and language is less important, and logic is less important."

***I am a traveler carrying one light bag and looking for a place to spend the night. I... discover a hostel of a sort in a large indoor space big enough to house a gymnasium. I find a spot near a corner and prepare for bed. I think to myself, "Luckily, I have my high-tech pillow." I take out of my bag a light, flat panel about 8 by 10 inches and the thickness of a thick piece of cardboard. "It works by applying a voltage," I say. "There's a new kind of material which fluffs up when you apply a voltage." On the face of the panel is a liquid-crystal display with two buttons, one labeled "on" and one labeled "off." I touch the "on" button with my index finger, and the flat panel magically inflates to the dimensions of a fluffy pillow. I lay it down on the ground and comfortably go to sleep. - Chuck, scientist (from Dreambank.net)***

If Chuck's experience is an example of logic gone to sleep, no wonder dreamers so often wake up shouting, "Eureka!" Indeed, history is filled with examples of inspiration that blossomed during sleep and eventually led to inventions or works of art or military moves. Exactly what

happens to inspire creativity is unclear, but the new technology is providing clues.

**Crazy smart.** Brain scans performed on people in REM sleep, for example, have shown that even as certain brain centers turn on--the emotional seat of the brain and the part that processes all visual inputs are wide awake--one vital area goes absolutely dormant: the systematic and clear-thinking prefrontal cortex, where caution and organization reside. "This can explain the bizarreness you see in dreams, the crazy kind of sense that your brain is ignoring the usual ways that you put things together," says Robert Stickgold, associate professor of psychiatry at Harvard and director of the Center for Sleep and Cognition at Beth Israel Deaconess Medical Center. "This is what you want in a state in which creativity is enhanced. Creativity is nothing more and nothing less than putting memories together in a way that they never have been before."

Putting memories together is also an essential part of learning; people integrate the memory of new information, be it how to tie shoelaces or conjugate French verbs, with existing knowledge. Does dreaming help people learn? No one knows--but some sort of boost seems to happen during sleep. Many studies by sleep researchers have shown that people taught a new task performed it better after a night of sleep.

A study of how quickly dreamers solve problems supports Stickgold's theory that the sleeping mind can be quite nimble and inventive. Participants were asked to solve scrambled word puzzles after being awakened during both the REM phase of sleep and the less active non-REM phase. Their performance improved by 32 percent when they worked on the puzzles coming out of REM sleep, which told researchers that that phase is more conducive to fluid reasoning. During non-REM sleep, it appears, our more cautious selves kick into gear.

Indeed, PET scans of people in a non-REM state show a decline in brain energy compared with REM sleep and increased activity in those dormant schoolmarm-ish lobes. Does this affect the content of dreams? Yes, say researchers from Harvard and the Boston University School of Medicine. Since people should theoretically be more uninhibited when the controlling prefrontal cortex is quiet, the team tracked participants for two weeks to see if their REM dreams were more socially aggressive than the ones they reported during non-REM sleep. The REM dreams, in fact, were much more likely to involve social interactions and tended to be more aggressive.



***I had a horrible dream. Howard was in a coffin. I yelled and screamed at his mom that it was all her fault. I kicked myself that I hadn't waited to become a widow rather than a divorcee in order to get the insurance. I woke up feeling miserable, the dream was so icky. - Barb (from Dreambank.net)***

To many experts, Barb's bad dream would be a good sign, an indication that she would recover from the sorrow of her divorce. A vivid dream life, in which troubled or anxious people experience tough emotions while asleep, is thought to act, in the words of Cartwright, as "a kind of internal therapist."

The enduring and vexing question is: How much of value do dreams say? Despite all the efforts to quantify, to measure, no one has an answer yet. But dreams have played a role in psychotherapy for over a century, since Freud theorized that they signal deep and hidden motivations. "A dream is the one domain in which many of a patient's defenses are sufficiently relaxed that themes emerge that ordinarily would not appear in waking life," says Glen Gabbard, professor of psychiatry and psychoanalysis at Baylor College of Medicine.

Sometimes, dreams can be a helpful diagnostic tool, a way of taking the emotional temperature of a patient. The dreams of clinically depressed people are notable for their utter lack of activity, for example.

Might there be a physiological reason? Eric Nofzinger, director of the Sleep Neuroimaging Research Program at the University of Pittsburgh medical school, has studied PET scans of depressed patients and has found that the difference between their waking and sleeping states is far less dramatic than normal. On the one hand, he says, "we were shocked, surprised, and amazed at how much activity" there was in the emotional brain of healthy people during sleep. In depressed patients, by contrast, the vigilant prefrontal cortex, which normally is not active during sleep, worked overtime. Never surrendering to the soothing power of dreams, the brain is physically constrained, and its dream life shows it.

**Healing power.** Is it possible that dreaming can actually heal? "We know that 60 to 70 percent of people who go through a depression will recover without treatment," says Cartwright, percent of people who go through a depression will recover without treatment," says Cartwright, who recently tested her theory that maybe they are working through their troubles while asleep. In a study whose results were published this spring in the journal *Psychiatry Research*, she recruited 30 people going through a divorce and asked them to record their dreams over five months. Depressed patients whose dreams were rich with emotion--one woman reported seething while her ex-husband danced with his new girlfriend--eventually recovered without the need for drugs or extensive psychotherapy. But those whose dreams were bland and empty of feeling were not able to recover on their own.

***I've sat straight up in bed many times, reliving it, re-seeing it, rehearsing it. And it's in the most absurd ways that only a dream could depict...the one that comes to mind most, dreaming of a green pool in front of me. That was part of the radarscope. It was a pool of gel, and i reached into the radarscope to stop that flight. but in the dream, I didn't harm the plane. I just held it in my hand, and somehow that stopped everything.*** - Danielle O'Brien, air traffic controller for American Airlines Flight 77, which crashed into the Pentagon on Sept. 11, 2001 (in an interview with ABC News)

Many clinicians working with traumatized patients have found that their nightmares follow a common trajectory. First, the dreams re-create the horrors; later, as the person begins to recover, the stories involve better outcomes. One way to help victims of trauma move on is to encourage them to wake themselves up in the midst of a horrifying dream and consciously take control of the narrative, to take action, much as O'Brien appears to have done in her dream. This can break the cycle of nightmares by offering a sense of mastery. "If you can change the dream content," says Harvard's Barrett, author of *Trauma and Dreams*, "you see a reduction in all the other post-traumatic symptoms."

Cartwright recalls helping a rape victim who came in suffering from nightmares in which she felt an utter lack of control; together, they worked to edit the young woman's dreams of being in situations where she was powerless--of lying on the floor of an elevator without walls as it rose higher and higher over Lake Michigan, for example. "I told her, 'Remember, this is your construction. You made it up, and you can stop it,'" says Cartwright, who coached the woman to recognize the point at which the dream was becoming frightening and try to seize control. At the next session, the woman reported that, as the elevator rose, she decided to stand in her dream and figure out what was happening. The walls rose around her until she felt safe.

A window? A royal road? A way for the brain to integrate today with yesterday? While definitive answers remain elusive, the experience of dreaming is clearly as universal as a heartbeat and as individual as a fingerprint--and rich with possibilities for both scientist and poet.

**SUMMARY:**

**QUESTION FOR DISCUSSION:**